

This method of operation was prepared from Issue 19 of drawing ES-226617.

#### METHOD OF OPERATION

Panel Systems - 2-Party Message Line and Trip Circuit  
Panel Line Finder - Battery Grounded at End

#### DEVELOPMENT

##### 1. PURPOSE OF CIRCUIT

1.1 This circuit is used to establish connections between subscribers' stations and the apparatus in the panel office.

##### 2. WORKING LIMITS

2.1 This circuit has a maximum external loop resistance of 1500 ohms with an earth potential of +20 to -14 volts and a minimum leak resistance of 10,000 ohms.

#### OPERATION

##### 3. PRINCIPAL FUNCTIONS

3.1 To cause the start circuit to function and start a line finder selector hunting for the calling line.

3.2 To trip the proper Line Finder brushes.

3.3 To operate the proper message register on a charge call.

3.4 To operate the Line Finder Time Alarm Circuit.

3.5 To disconnect battery and ground from the subscribers' line on an incoming call.

3.6 When 2 party lines are arranged for remote control zone registration or non-zone overtime, the operation of a polar relay operates either of the 2 registers, depending on the polarity of the charging current furnished by the district.

3.7 A cover switch is provided on the polar relay, to prevent false operation of subscribers' registers when testing or adjusting this relay.

3.8 Provides for line load control.

**4. CONNECTING CIRCUITS**

This line and trip circuit will function with:

4.1 Start circuit.

4.2 2 Party line finder district.

4.3 Line load control circuit.

**DESCRIPTION OF OPERATION****5. ORIGINATING A CALL**

The operation of a call originating in the first ten lines of a group is as follows: When the receiver at the calling station is removed from the switch-hook, the (L) relay in the line circuit operates over the ring side of the line through the subscriber's loop, back over the tip side to ground. The line relay (L) operated, connects battery to the H terminal of the line and operates the (BA) relay through its inner winding. The (BA) relay operated, operates the (TR) relay from ground on the armature of the (BA) relay, break contact of the (K) relay, 700 ohm winding of the (TR) relay to battery over the (TR) lead. The (TR) relay operated, (a) operates the two trip magnets, (b) opens the locking series circuit through the (TR) relays in the other bank groups and (c) locks through its 600 ohm winding to battery on terminal 1 and brush of the G group distributor selector, in series with the (STA) relay in the start circuit.

**6. STARTING A LINE FINDER**

When the (STA) relay in the Start circuit operates, it starts a line finder hunting for the calling line. Each TRIP magnet operates its trip rod, thus tripping the corresponding group brushes of the associated selectors on its respective side of the frame as the line finder selector starts upward. Ground on the K lead operates the (K) relay which, (a) locks to ground on the armature of the (BA) relay under control of the (O) relay (b) opens the circuit through the 700 ohm winding of the (TR) relay, thus preventing another line finder selector from being started by this call, (c) closes a circuit from the 1500 ohm winding of the (O) relay, but the (O) relay does not operate at this time on account of

insufficient current through the winding. As the line finder selector moves upward and at the end of the tripping zone, ground on the K commutator brush and segment, short circuits the 600 ohm winding of the (TR) relay. The (TR) relay released, closes the locking series circuit through the (TR) relays in the other groups and opens the circuit through the two trip magnets, which release.

7. RELEASING THE TRIP CIRCUIT

When the selector brushes make contact with the terminals associated with the calling line, battery on the H terminal operates the (O) relay. The (O) relay operated, opens the locking circuit of the (K) relay but the (K) relay is very slow in releasing and holds the (O) relay operated through the 1500 ohm winding in order to permit the (BA) relay to release before the (O) relay, otherwise another line finder may be started by this call. When the line has been found the district functions and connects battery to lead S, operating the (CO) relay. The (CO) relay operated, releases the line (L) relay which in turn releases the (BA) relay thus opening the circuit, releasing the (O) relay. Another call may now start within this same group of ten lines if the start circuit is ready for the call. The operation for a call originating in the last ten lines of a group of twenty, will be similar to that already described for the first ten lines except that the (BA-1), (K-1), (O-1) and (TR-1) relays are involved instead of the (BA), (K), (O), and (TR) relays.

8. SIMULTANEOUS CALLS

If there are simultaneous calls in both the first and last ten lines of a group of twenty lines, the relays of both sub-groups will operate as already described, starting two line finder selectors in different sub-groups at the same time. In this case, the inner windings of the (O) and (O-1) relays are connected together through the make contacts of the (BA) and (BA-1) relays. The (O) and (O-1) relays will therefore operate in parallel when the H brush of either or both line finder selectors make contact with the H terminals of the calling line.

9. MESSAGE REGISTER

9.1 Fig. 2, "X" Wiring

The two party message register district which is associated with this circuit is arranged to test the subscribers line

to determine which subscriber is calling. When this test has been made and the district advances to its message registering position, the (CO) relay is either held operated or released depending upon which party is calling and battery is connected to lead H, thus operating the (MR-1) or (MR-2) message register.

#### 9.2 Fig. 2 "Y" Wiring or Fig. 6, with Figs. 3, 4 and 5

When the call has reached the stage where the district applies the charging current on the H lead, the (P) relay is operated in a direction depending on the polarity applied to the H lead. When negative polarity is applied to the H lead, contacts 3T and 4T of relay (P) are closed, operating the (MR1) register, and when positive polarity is applied, contacts 1T and 2T of relay (P) are closed, operating the (MR2) register. The removal of either potential applied allows the (P) relay to release, in turn releasing the (MR1) or (MR2) register as the case may be.

A cover switch is provided on the (P) relay, which is so arranged that when the cover cap is removed, contacts 1B and 2B are opened, removing battery from springs 2T and 3T, in order to prevent false operation of the registers when the (P) relay is being adjusted or tested.

#### 10. TERMINATING CALLS

When the final selector connects to the tip, ring and sleeve terminals of an idle line at the final multiple, battery through a resistance in the final circuit is connected over the S lead to ground through both windings of the (CO) relay (on individual lines or the last line of a group of consecutive lines) or through the 100 ohm winding of the (CO) relay (on intermediate lines of a group of consecutive lines). The (CO) relay operated, disconnects the (L) relay battery bridge from across the tip and ring of the line. When the final selector returns to normal, the circuit through the winding of the (CO) relay is opened, releasing the relay and restoring the circuit to normal.

#### 11. OPERATION OF LINE LOAD CONTROL FEATURE - (Fig. 7)

When this feature is provided, all the lines in the office may be grouped into 3 classes, A, B and C. Some

lines in each class may be provided in each line finder group, but all the lines associated with any one trip circuit must be of the same class.

The line load control feature is not provided for class A lines, but is provided for classes B and C.

To operate the line load control feature for class B lines, the proper keys in the line load control circuit are operated, causing the operation of the (LB1), (LB2) and (LB3) relays. These relays operating, (a) operate the (O) and (O1) relays of all class B trip circuits, thereby opening the operating paths of the (TR) and (TR1) relays in the trip circuits, and (b) open the B lead from the line finder time alarm to class B trip circuits, thereby preventing the time alarm and release features from functioning. Relay (LB3) operating, also lights a lamp associated with the class B lines of the line finder group and provides for operating an alarm in the line load control circuit.

To operate the line load control feature for class C lines, the proper keys in the line load control circuit are operated. The operation is the same as described above for class B lines, except that the (LC1), (LC2) and (LC3) relays operate to perform the functions described above.

When the keys in the line load control circuit are restored, the (LB1), (LB2), (LB3), (LC1), (LC2) and (LC3) relays release, restoring the circuit to normal.

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